# Improved Use of the Inspection Selection System (ISS) for Motor Carrier Safety: Development of an Intrastate ISS for Wisconsin Using the SafeStat Methodology

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Final Report

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16. Abstract

Initially, a simple "Direct Estimation" method for identifying vehicles likely to have Out-of-Service (OOS) violations was developed and validated (the Intrastate ISS). The method only requires historical data on carrier OOS violations. A telephone survey also was conducted of 14 states that were the most likely to be developing their own Intrastate ISS. Subsequently, Missouri was found to have developed its own Intrastate SafeStat methodology that was consistent with the data available in Wisconsin and thus could be used as a model for Wisconsin.

The focus of Wisconsin's Intrastate SafeStat methodology is on selecting carriers for Intrastate Compliance Review. Carriers are placed in rank order based on historical inspection data (the Total OOS Rate) and data on total crashes. The Final Carrier Ranking does generally identify the carriers with the highest number of "Crashes per Carrier." The one major exception to the pattern of higher "Crashes per Carrier" for the higher Percentile Groups is explained by the lack of inspection data for the carriers with the largest number of crashes.

The SafeStat methodology was validated by tabulating the "Crashes per Carrier" for a subsequent time period. The methodology, however, is limited by the lack of exposure data for carrier crashes. The methodology can be implemented immediately and can be easily updated with the most recent inspection and crash data. The most important next step would be to develop a measure of carrier size for intrastate carriers in Wisconsin.


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# INTRODUCTION

In the early 1990s, the Federal Highway Administration (FHWA) began to support the development of the Inspection Selection System (ISS). This program was initiated to help states improve the effectiveness of their roadside safety inspections of interstate commercial vehicles by making it easier to identify vehicles from carriers with the worst past performance on inspections and compliance reviews (1).

In 1993, the U.S. Department of Transportation's Volpe National Transportation Systems Center began research to define and propose an improved process to assess motor carrier safety fitness for the FHWA, Office of Motor Carriers. The objectives of the research project included the development of a single methodology for measuring motor carrier safety fitness and the definition of a comprehensive process to improve the safety status of problem carriers. The result of the project was the Motor Carrier Safety Status (SafeStat) Measurement System (2). SafeStat was first implemented as part of the Commercial Vehicle Information System (CVIS) program (now known as the Performance and Registration Information Systems Management – PRISM – program).

The federal SafeStat uses interstate motor carrier performance and compliance data to assess the safety fitness of a particular motor carrier in four broad Safety Evaluation Areas (SEA). The Crash SEA is based on a measure of crashes per power unit. The Driver and Vehicle SEAs are based on Out-of-Service inspection violations, while the Safety Management SEA is based primarily on data from Compliance Reviews. Carriers are placed in rank order in each of the four SEA areas. A weighted sum of the rankings is then obtained to provide an overall SafeStat score for each carrier. Emphasis is placed on carriers that are ranked at the $75^{th}$ percentile or higher in each SEA area.

SafeStat relies on the USDOT Number as an identifier to integrate multiple sources of data from all of the states. This number is required by federal regulations to be issued to all interstate motor carriers. In Wisconsin, carriers that only operate in Wisconsin (intrastate carriers) are not required to obtain a USDOT number. Thus, the federal SafeStat cannot be applied to intrastate carriers in Wisconsin. The same limitation also applies to the federal ISS.

## PROJECT OBJECTIVES AND PRIOR WORK

The two primary objectives of this project are: 1) to develop an Intrastate Inspection Selection System (ISS) that will permit inspectors to select commercial vehicles for inspection that have a high likelihood of having Out-of-Service (OOS) violations; and 2) to develop a methodology for ranking intrastate carriers in Wisconsin in order to enhance the selection of carriers for Wisconsin's Intrastate Compliance Review (Carrier Audit) program.

In meeting these objectives, a number of project tasks were completed: Task 1) survey of other states to identify similar work on the development of an Intrastate ISS; Task 2) development of a list of internal and external stakeholders who should be involved in the project; Task 3) development and validation of an Intrastate ISS for identifying OOS violations, and Task 4) development and validation of a methodology for selecting carriers for Wisconsin's Intrastate Compliance Review program.

Task 1. While the work on Task 3 was in progress, a telephone survey was conducted of 14 states that Federal Motor Carrier Safety Administration staff identified as currently requiring intrastate carriers to obtain a USDOT Number. These states were most likely to have the capability of developing an Intrastate ISS because of the availability of the USDOT Number. The results of the survey showed that 13 of the 14 states did require USDOT Numbers for their intrastate carriers. Most of the states had completed the initial carrier registration process; however, none of the states had yet developed its own Intrastate ISS.

After the telephone survey had been completed, Missouri was identified as having developed its own version of the federal SafeStat program (4). Missouri uses its Intrastate SafeStat, the MO SafeStat, to choose motor carriers for Safety Compliance Reviews. The MO SafeStat program closely mirrors the federal SafeStat program. The MO SafeStat system focuses on intrastate motor carriers that have demonstrated poor performance through roadside inspections and commercial vehicle crashes. MO SafeStat assesses motor carriers in three broad Safety Evaluation Areas (SEA): 1) the Crash SEA; 2) the Driver SEA, and 3) the Vehicle SEA. Currently, if a motor carrier is unacceptable in any of the three SEAs, it may be targeted for an on-site Compliance Review. The selection system includes motor carriers whose scores rank in the top 33 percent of worst performers. Initial application of the MO SafeStat for Compliance Review resulted in unsatisfactory ratings for about 70 percent of the carriers.

Task 2. An initial list of internal and external stakeholders was developed early in the project. Once the Intrastate ISS was completed (Task 3), key internal and external stakeholders were contacted. There was favorable reaction to the overall methodology used for Task 3. External stakeholders were concerned about clearly identifying mechanisms that carriers with poor performance could use to get "off the list." The duration of the time period used to identify poor performance (currently three years) was also an issue.

Task 3. The initial focus of this project was task 3 – the development and validation of an Intrastate ISS. The federal Interstate ISS was used as the starting point for developing a similar model for Wisconsin conditions. Only data currently available in Wisconsin was to be used. The primary limitation of Wisconsin's data on motor carriers was that Wisconsin does not require intrastate carriers to obtain a federal USDOT Number. Carriers that apply for a USDOT Number provide data on carrier size (number of power units and number of drivers). Carrier size data is not currently available for Wisconsin's intrastate carriers. Intrastate carriers in Wisconsin that have had one or more roadside inspections or have had crashes have been assigned a Wisconsin carrier number ("S number"). These "S numbers" provided the basis for developing historical data on inspections and crashes for these carriers.

The results of Task 3 were documented in a Draft Report (3). The most useful method for predicting inspections resulting in an Out-of-Service (OOS) violation was found to be the "Direct Estimation" method. In this method, carriers' historical inspection data on OOS violations are used to predict their future performance. The "Direct Estimation" method produced slightly better success rates when using the "Total Out-of-Service Rate" (Total OOS Rate) variable, which is the sum of OOS violations divided by the number of inspections for each carrier for a specified time period. The adequacy of a model based on a single independent variable was verified by evaluating the statistical validity of alternative independent variables using a logistics regression model. Validation of the "Direct Estimation" model with inspection data for 1999 showed that the model could identify a substantial number of carriers (81 out of 914 total) that had OOS violation rates of 56 percent or higher, compared to the average for all carriers in the 1999 database of 28 percent. A larger group of carriers (233 out of 914 total) were found to have OOS violation rates of 44 percent or higher.

Task 4. The primary purpose of this final report is to document the extension of the initial work on the development of the Wisconsin Intrastate ISS (Task 3) to include a modified version

of the Federal SafeStat methodology. The initial analysis only used data on roadside inspections. This extension using the SafeStat methodology adds data on carrier crashes. The focus is now on identifying carrier crash potential rather than only poor performance in roadside inspections.

## METHODOLOGY FOR SELECTING CARRIERS FOR COMPLIANCE REVIEW

The federal SafeStat program provides a possible methodology; however, the complete federal SafeStat methodology cannot be used in Wisconsin because of the lack of carrier size data. Consequently, a simplified version of the Missouri Intrastate SafeStat program that is similar to the federal SafeStat program will be applied to Wisconsin data and evaluated in terms of the ability of the methodology to identify carriers with high levels of crashes.

### Differences Between MO SafeStat and Federal SafeStat

The MO SafeStat uses a modified version of the federal SafeStat methodology. One major difference is that the MO SafeStat does not normalize the number of crashes per carrier by the carrier's size (number of power units). Also, the MO SafeStat includes carriers with only one crash, while the federal program considers carriers with only one crash separately. The MO SafeStat does not weigh the Crashes SEA by the factor of 2.0 that is used by the federal methodology (4).

Another minor difference is that the MO SafeStat ranks carriers that receive a SEA percentile ranking of 67 or higher, while the federal SafeStat only ranks carriers with an SEA percentile ranking of 75 or higher. Missouri also considers Hazardous Materials crashes in more detail than the federal program.

### Proposed Wisconsin Intrastate SafeStat

For implementation in Wisconsin, a simplified version of the Missouri Intrastate SafeStat methodology is used to add carrier crash data to the Wisconsin Intrastate Inspection Selection System (ISS). The result of the process is the Final Carrier Rank which provides the basis for the Wisconsin Intrastate SafeStat. The primary difference between the two methodologies is the use of Wisconsin's Total OOS Rate in place of Missouri's Vehicle SEA and Driver SEA. Below is the summary of what is to be done in Wisconsin.

1. Use a three-year time window to obtain the total number of crashes for each carrier. Include carriers with one or more crashes. Do not include any weighting by crash type or by time period within the three years.
2. Merge the inspection-based Total OOS percentile ranking of carriers with the crash-based percentile ranking of carriers with equal weighting of both rankings to create the Final Carrier Rank.
3. Validate the Wisconsin Intrastate ISS for selection of carriers for Compliance Review based on analysis of historical crash experience.

The overall process used to create the Final Carrier Rank is shown in Figure 1. The data available and the individual steps in the process are discussed in the next two sections.

## DATA AVAILABLE

The primary data available for this project are:

1. Database of crashes for intrastate motor carriers in Wisconsin for the years 1995 through July 2000. The data file covers 6,211 crashes involving intrastate vehicles for the five-and-a-half year time period.

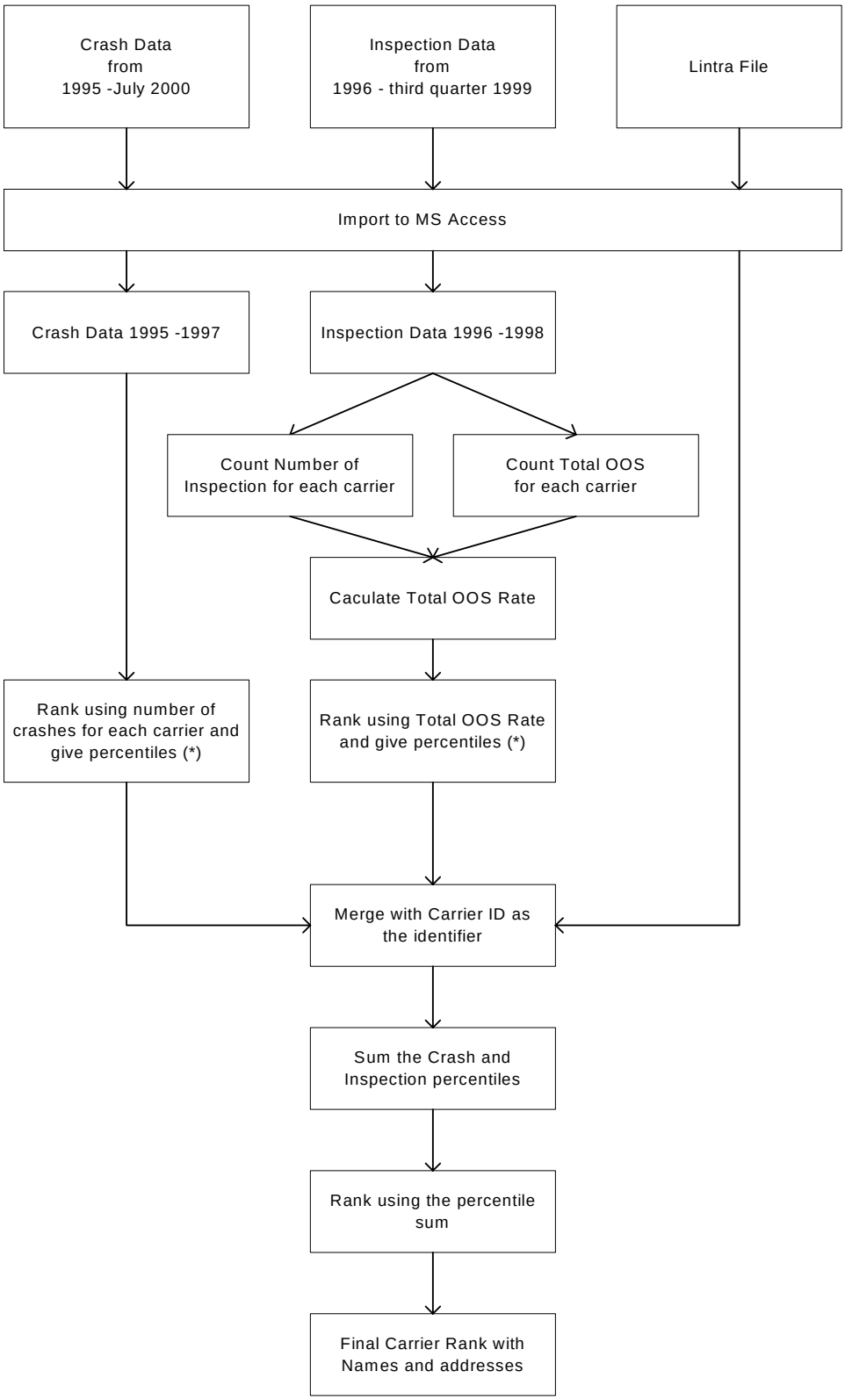
2. Database of inspections from roadside inspections of intrastate motor carriers in Wisconsin for the years 1996 through the third quarter of 1999. The database contains 12,135 inspections of intrastate vehicles for the period of nearly four years.

## DATABASE ANALYSIS

### Inspection Data

The inspection analysis is based on data from 1996 through 1998. Using the method from the development of the Wisconsin Intrastate ISS, the database is manipulated to produce the Total Out of Service (Total OOS) rate for every carrier in the database.

1. Do a count on all of the inspections dated 1996 through 1998, calculating the Total OOS (sum of the OOS violations) for each carrier. There are a total of 2,327 inspections recorded in 1996, 4,197 in 1997, 3,642 in 1998, and 1,969 through the third quarter of 1999.
2. Do a count on all of the inspections dated 1996 through 1998 to obtain the total number of inspections for each carrier. During 1996 to 1998, 6,105 carriers were inspected.




(*) = Export the tables to Excel, give rankings, give percentiles, import back to Access

Figure 1. Flow Diagram of Process to Create the Final Carrier Rank

3. Do a count on all of the inspections dated 1996 through 1998 to obtain the total number of inspections for each carrier. During 1996 to 1998, 6,105 carriers were inspected.
4. Calculate the Total OOS Rate for each carrier by dividing the Total OOS by the total number of inspections.
5. Sort the result by descending Total OOS Rate.
6. Give a percentile to each carrier. The highest Total OOS Rate receives 100 and the lowest Total OOS Rate receives 0.
7. Assign 0 to carriers with a percentile less than 66.67. From the total of 6,105 carriers, there are 2,036 carriers that have a percentile score greater than 66.67

Carriers with the 20 highest OOS Rates are shown in Table 1.

**Table 1. Top 20 Wisconsin intrastate carriers with the highest OOS rates**

| Rank | Carrier ID | OOS Rate | Percentile |
|---|---|---|---|
| 6105 | S015952 | 14 | 100 |
| 6104 | S014862 | 13 | 99.98362 |
| 6103 | S004775 | 12 | 99.96724 |
| 6102 | S006126 | 12 | 99.95086 |
| 6101 | S012664 | 12 | 99.93448 |
| 6100 | S013717 | 12 | 99.9181 |
| 6099 | S015500 | 12 | 99.90172 |
| 6098 | S015775 | 12 | 99.88534 |
| 6097 | S012212 | 11 | 99.86896 |
| 6096 | S012948 | 11 | 99.85258 |
| 6095 | S013233 | 11 | 99.8362 |
| 6094 | S008718 | 10 | 99.81982 |
| 6093 | S013486 | 10 | 99.80344 |
| 6092 | S015075 | 10 | 99.78706 |
| 6091 | S016131 | 10 | 99.77068 |
| 6090 | S006572 | 9.5 | 99.7543 |
| 6089 | S012132 | 9 | 99.73792 |
| 6088 | S013530 | 9 | 99.72154 |
| 6087 | S013898 | 9 | 99.70516 |
| 6086 | S014028 | 9 | 99.68878 |

## Crash Data

The crash data that are being used for the model are the crash data for three years from 1995 through 1997. Data for the remaining two full years will be used for model validation. As shown in Table 2, crash data for intrastate commercial vehicles in Wisconsin are available for 1995 through July 2000.

**Table 2. Crash data available**

| Year | Crashes |
|---|---|
| 1995 | 1238 |
| 1996 | 1287 |
| 1997 | 1114 |
| 1998 | 1046 |
| 1999 | 1007 |
| 2000 | 518 |

1. Do a count on all crashes dated 1995 through 1997, calculating the number of crashes for each carrier. The total number of carriers is 2,297. Sort the result with descending number of crashes.
2. Give a percentile to each carrier. The carrier with the highest number of crashes receives 100, and the lowest number of crashes receives 0. Carriers ranked in the top 20 (rank of 2,278 to 2,297) are shown in Table 3.
3. Assign 0 to carriers with a percentile less than 66.667.

Table 3. Top 20 Wisconsin intrastate carriers with the highest crashes per carrier

| Rank | Carrier ID | Crashes per carrier 1995-97 | Percentile |
|---|---|---|---|
| 2297 | S006430 | 180 | 100 |
| 2296 | S006423 | 53 | 99.95646 |
| 2295 | S007487 | 49 | 99.91293 |
| 2294 | S009010 | 38 | 99.86939 |
| 2293 | S003693 | 28 | 99.82586 |
| 2292 | S007047 | 28 | 99.78232 |
| 2291 | S002592 | 26 | 99.73879 |
| 2290 | S009254 | 23 | 99.69525 |
| 2289 | S003886 | 21 | 99.65172 |
| 2288 | S011349 | 18 | 99.60818 |
| 2287 | S006490 | 16 | 99.56465 |
| 2286 | S008595 | 16 | 99.52111 |
| 2285 | S005498 | 15 | 99.47758 |
| 2284 | S008786 | 15 | 99.43404 |
| 2283 | S012014 | 15 | 99.39051 |
| 2282 | S007042 | 13 | 99.34697 |
| 2281 | S008569 | 13 | 99.30344 |
| 2280 | S008577 | 13 | 99.2599 |
| 2279 | S011185 | 13 | 99.21637 |
| 2278 | S009975 | 12 | 99.17283 |

Table 4 shows the ranking at which the number of crashes drops to 1 (Rank of 1,869). Thus, only 428 carriers have more than one crash in the three-year time period.

**Table 4. Lowest rank for two crashes per carrier**

| Rank | Carrier ID | Crashes per carrier 1995-97 | Percentile |
|---|---|---|---|
| 1871 | S014562 | 2 | 81.45407 |
| 1870 | S014943 | 2 | 81.41054 |
| 1869 | 635730 | 1 | 81.367 |
| 1868 | 689364 | 1 | 81.32347 |
| 1867 | 696995 | 1 | 81.27993 |

## Combining Inspection Data and Crash Data

Only carriers that are in the top one-third of each database are selected for the combined database (carriers with a percentile score of 66.67 or greater).

1. Merge the selected carriers from the crash and inspection databases. The result is a table with columns: Carrier ID (S Number), Percentile Crashes, and Percentile Inspections.

   From the crash data that are selected (percentile 66.67 and more), there are 766 carriers listed having crashes within the time range. From the inspection data that are selected, there are 2,036 carriers listed within the time range. When the two databases are combined, it is found that only 135 carriers are actually listed on both of the databases. This means that 1,901 carriers are only listed in the inspection database and 631 carriers are only listed in the crash database. The total number of carriers in the merged database is 2,667 (sum of 1,901 plus 631 plus 135).
2. Sum the two percentiles.
3. Sort the table based on the descending Percentile Sum. The result for the top five carriers is shown in Table 5.

Table 5 shows that the top-ranked carriers all have both Percentile Crash and Percentile Inspection rankings. In fact, all the 135 carriers that are found in both of the databases (and thus have both rankings) must be at the top of the Percentile Sum ranking. Both the crashes and inspection rankings will have a score between 66.67 and 100 with a sum of at least 133.33. The rest of the carriers will have a smaller percentile sum because if they receive an inspection ranking (maximum score of 100), then the score for the crash data will be zero, and vice versa.

**Table 5. Top 5 of the combined data from the crash and inspection percentiles**

| Carrier ID | Percentile Crash | Percentile Inspection | Percentile Sum |
|---|---|---|---|
| S004000 | 90.94471049 | 99.47583948 | 190.42055 |
| 707124 | 92.64257727 | 96.88779689 | 189.5303742 |
| S003571 | 91.3365259 | 98.18181818 | 189.5183441 |
| S003229 | 95.60296038 | 92.82555283 | 188.4285132 |
| S007667 | 94.51458424 | 93.44799345 | 187.9625777 |

4. Give percentiles to the new order of carriers. The highest value of the Percentile Sum receives 100, and the lowest value of the Percentile Sum receives 0.

The result from the last step will be the percentile and the rank of carriers with the worst performing carriers at the top. The result for the top 20 carriers is shown in Table 6.

**Table 6. Top 20 from the Final Carrier Rank**

| Carrier ID | Percentile Sum | Rank | Rank Percentile | Crashes 1995-1997 | Crashes 1998-1999 |
|---|---|---|---|---|---|
| S004000 | 190.42055 | 2667 | 100 | 2 | 0 |
| 707124 | 189.5303742 | 2666 | 99.96250469 | 2 | 0 |
| S003571 | 189.5183441 | 2665 | 99.92500937 | 2 | 1 |
| S003229 | 188.4285132 | 2664 | 99.88751406 | 3 | 1 |
| S007667 | 187.9625777 | 2663 | 99.85001875 | 3 | 0 |
| S003388 | 185.395315 | 2662 | 99.81252343 | 2 | 1 |
| S002558 | 184.9349345 | 2661 | 99.77502812 | 2 | 1 |
| S004071 | 184.3327889 | 2660 | 99.73753281 | 2 | 0 |
| S009751 | 184.285724 | 2659 | 99.7000375 | 3 | 0 |
| S003045 | 183.7180783 | 2658 | 99.66254218 | 2 | 1 |
| S004334 | 183.6840632 | 2657 | 99.62504687 | 2 | 0 |
| S010854 | 183.6374333 | 2656 | 99.58755156 | 3 | 0 |
| S011480 | 183.2887179 | 2655 | 99.55005624 | 3 | 0 |
| S005115 | 182.9987125 | 2654 | 99.51256093 | 2 | 0 |
| S008980 | 182.9587073 | 2653 | 99.47506562 | 2 | 0 |
| S003952 | 182.7598723 | 2652 | 99.4375703 | 2 | 0 |
| S004225 | 182.3788319 | 2651 | 99.40007499 | 2 | 0 |
| S003894 | 181.8824967 | 2650 | 99.36257968 | 4 | 2 |
| S006171 | 181.4242913 | 2649 | 99.32508436 | 4 | 2 |
| S008699 | 181.1612055 | 2648 | 99.28758905 | 2 | 0 |

## Names and Addresses from the "Lintra" File

Looking at the result of the Final Carrier Ranking shown in Table 6, all we can see is the list of Carrier IDs (S Numbers) with the percentile numbers attached to it. To make the list more meaningful, we need to add the carrier names and addresses. The "Lintra" file contains a one-to-

one correspondence between the S Numbers and the Carrier Names and Addresses. The carrier name and address from the "Lintra" file was merged with the Final Carrier Rank file using a database program.

The merge produced a reasonable match. From the 2,667 carriers ranked in the Final Carrier Rank table, there are 2,602 carriers that have their names and addresses in the "Lintra" file. The top 5 records from the merge are shown in Table 7. The carrier ranked number 2 does not have a record in the "Lintra" file. This carrier has a Carrier ID that corresponds to a USDOT Number rather than an S Number. The carrier name and address should be available from the federal USDOT Number database.

**Table 7. Top 5 carriers from the Final Carrier Rank with carrier names and addresses**

| Carrier ID | CARRIERNAME | ADDRESS | CITY | STATE | ZIPCODE |
|---|---|---|---|---|---|
| S004000 | KENNETH L HERBRAND | 5273 EASY ST | WAUNAKEE | WI | 53597 |
| 707124 | | | | | |
| S003229 | RONALD C LUEDTKE INC | 666 WATER ST | LOMIRA | WI | 53048 |
| S007667 | DOHERTY SEAN | W7704 HWY Q PO BOX 226 | POYNETTE | WI | 53955 |
| S003388 | GENESEE AGGREGATE TRUCKING INC | PO BOX 27518 | MILWAUKEE | WI | 53227 |

## Evaluation of the Final Carrier Rank Table

The primary reason for generating the Carrier Rank Table is to identify carriers with high levels of crashes. The extent to which the final ranking of the carriers identifies carriers with high levels of crashes is shown in the left half of Table 8. The carriers are grouped by "Percentile Group" and the crashes per carrier within each group are shown. As expected, the general pattern is for a decrease in crashes per carrier with decreasing "Percentile Group"; however, the 90-94 Percentile Group does not fit the pattern.

The reason for the lower crashes per carrier for the 95-100 Percentile Group compared to the 90-94 Percentile Group relates to the extent of overlap between the inspection and the crash databases. As described earlier, there are 135 carriers that have both crash and inspection data (ranking scores between 66.67 and 100). Thus, the sum will generate a score that will always be larger than the score for the remaining carriers with only a ranking for either crashes or inspections (maximum value of 100). Also, carriers that have the highest ranking for crashes, in general, do not have any inspections. These carriers tend to be government agencies or other carriers that only operate in urban areas. Thus, they do not pass through inspection stations.

These carriers, then, fall below the 135 carriers with both crash and inspection data. All but one of the 135 carriers fall in the 95-100 Percentile Group.

**Table 8. Crashes per carrier for each Percentile Group for 1995-97 and 1998-99**

| Percentile Group | Number of Carriers | Percent of Total | Sum of Crashes 1995-97 | % of Total | Crashes per Carrier | | Sum of Crashes 1998-99 | Expanded 1998-99 Sum | 1998-99 Crashes % of Total | Crashes per Carrier |
|---|---|---|---|---|---|---|---|---|---|---|
| 0-9 | 266 | 9.97 | 90 | 4.1 | 0.3 | | 34 | 51 | 4.2 | 0.2 |
| 10-19 | 267 | 10.01 | 65 | 2.9 | 0.2 | | 10 | 15 | 1.2 | 0.1 |
| 20-29 | 267 | 10.01 | 78 | 3.5 | 0.3 | | 29 | 43.5 | 3.6 | 0.2 |
| 30-39 | 266 | 9.97 | 70 | 3.2 | 0.3 | | 25 | 37.5 | 3.1 | 0.1 |
| 40-49 | 267 | 10.01 | 149 | 6.7 | 0.6 | | 55 | 82.5 | 6.8 | 0.3 |
| 50-59 | 267 | 10.01 | 169 | 7.6 | 0.6 | | 45 | 67.5 | 5.5 | 0.3 |
| 60-69 | 266 | 9.97 | 132 | 6.0 | 0.5 | | 36 | 54 | 4.4 | 0.2 |
| 70-79 | 267 | 10.01 | 169 | 7.6 | 0.6 | | 52 | 78 | 6.4 | 0.3 |
| 80-89 | 267 | 10.01 | 301 | 13.6 | 1.1 | | 104 | 156 | 12.8 | 0.6 |
| **90-94** | **133** | **4.99** | **741** | **33.5** | **5.6** | | **382** | **573** | **47.0** | **4.3** |
| 95-100 | 134 | 5.02 | 251 | 11.3 | 1.9 | | 40 | 60 | 4.9 | 0.4 |
| All | 2667 | 99.98 | 2215 | 100.0 | 0.8 | | 812 | 1218 | 100.0 | 0.5 |

The extent to which the Final Carrier Rank can be used to predict future safety performance as measured by crashes per carrier is shown on the right side of Table 8. In order to compare the crash data for 1995 through 1997 and with that for 1998 through 1999, we need to expand the database in 1998-1999 to cover an equivalent three-year period. A factor of 1.5 is used to obtain the "Expanded 98-99 Sum." As shown in Table 8, the crashes per carrier for each of the groups decrease consistently between the two time periods. For example, in the 90-94 percentile group, from 741 crashes out of 133 carriers, the crashes decreased to 573 for the same 133 carriers. And in the 95-100 percentile group, the crashes decreased from 251 to 60.

To explain this consistent decline, it is helpful to look at the crash rate for the overall intrastate carrier population. The total number of crashes for 1995 to 1997 was 3,639. The total number of intrastate carriers listed in the Lintra file was 14,669, resulting in a crashes per carrier rate of 0.25. The statistical phenomenon known as the "Regression to the mean" can help to explain the observed consistent decline. The theory states that when a sample is based on the extremes of the population in one time period, then the values observed in a subsequent time period for the same sample will tend towards the population mean (regress to the mean of the overall population). With the overall crash sample, the crash rate in the first time period (0.8) is not likely to continue to be as high in the second time period. In fact, the observed crash rate for

the same 2,667 carriers in the next time period (0.5) is reasonable, because it moved toward the overall crash rate for the whole population (0.25).

In addition to the observed decline in the level of crashes between the two time periods, there are minor changes in the rank ordering of the Percentile Groups. For the 1995-1997 data, the percentile group that has the highest crash rate is the 90-94 percentile group, the second highest is 95-100 and the third is 80-89. In contrast, for the 1998-1999 data, the group with the highest crash per carrier rate is still 90-94, but the second is 80-89, and the third is 95-100. Also, in terms of total crashes for each percentile group as a percentage of all crashes, for 1998-1999 the 95-100 percentile group declines to the fourth highest compared to the second highest in 1995-1997. This suggests that the ranking of individual carriers changes somewhat between the two time periods. More consistent rankings might be obtained if only the Crash Inspection Ranking were used in the ranking process (omit the Inspection Ranking from the ranking process).

Overall as shown in Table 8, the Final Percentile Ranking appears to identify three general levels of safety performance: high crash rates (Percentile of 80 to 100), mid-range crash rates (Percentile of 40 to 79), and low crash rates (Percentile of 0 to 39). These percentile ranges are appropriate for both time periods. Thus, there are no changes in the "general level of safety performance" for any of the Percentile Groups between the two time periods.

The primary limitation of the Final Carrier Rank table for identifying carriers with "high safety risks" is that the crash data are not adjusted for exposure. For carriers that have the same level of safety risk as measured by crashes per vehicle operated (power units), the carrier that operates more vehicles will generate more crashes and thus be ranked higher in the Final Percentile Ranking. The federal SafeStat methodology avoids this problem by using the crashes per power unit for each carrier in generating the crash ranking.

## SUMMARY

The initial focus of this project was on the development of a tool (the Intrastate ISS) that would give inspectors the ability to select vehicles for inspection that would be more likely to have Out-of-Service (OOS) violations (Task 3). A simple "Direct Estimation" method was developed and validated. The method only requires historical data on carrier OOS violations.

Key external stakeholders reviewed the Intrastate ISS and voiced support for the overall methodology.

A telephone survey was conducted of 14 states that were the most likely to be developing their own Intrastate ISS. All but one of these states was requiring intrastate carriers to obtain a USDOT Number and had plans to use the Number to improve their monitoring of carrier safety performance. None of these states had yet developed its own Intrastate ISS. They also had not developed their own Intrastate SafeStat methodology that could be used as a model for Task 4 where the focus is on a methodology for selecting carriers for Interstate Compliance Review. Subsequently, Missouri was found to have developed its own Intrastate SafeStat methodology. Missouri's methodology was consistent with the data available in Wisconsin and thus was used as a model for the development of Wisconsin's Intrastate SafeStat methodology (Task 4).

Wisconsin's Intrastate SafeStat methodology involves merging the ranking of carriers based on historical inspection data (the Total OOS Rate) with the ranking based on historical data on total crashes. The resulting Final Carrier Ranking did generally identify the carriers with the highest number of "Crashes per Carrier". The one major exception to the pattern of higher "Crashes per Carrier" for the higher Percentile Groups was explained by the lack of inspection data for the carriers with the largest number of crashes.

The SafeStat methodology was validated by tabulating the "Crashes per Carrier" for a subsequent time period. A similar pattern in "Crashes per Carrier" by Percentile Group was found. The overall level of "Crashes per Carrier," however, was substantially lower in the subsequent time period because of the statistical phenomenon of "Regression to the mean." The methodology is also limited by the lack of exposure data for the carrier crash data. The federal SafeStat methodology uses carrier size (number of power units) to determine the carrier crash rate (crashes per power unit).

The strength of the proposed SafeStat methodology for Wisconsin is that it includes both inspection and crash data and thus provides a more comprehensive basis for selecting intrastate carriers for Compliance Reviews. No new data are required. Thus, the methodology can be implemented immediately and can be easily updated with the most recent inspection and crash data.

## RECOMMENDATIONS FOR ADDITIONAL STUDY

The most important next step would be to develop a measure of carrier size for intrastate carriers in Wisconsin. This should be possible by applying carrier identification software to the license plate file for trucks registered in Wisconsin. Additional study is also needed to determine the need for assigning weights to crashes by severity (property damage, injury and fatal). The need for separate consideration of driver and vehicle OOS violations could also be examined.

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